On page 53, please delete the paragraph beginning on line 20, and substitute therefor:

As shown in FIG. 3, in addition to heat sources 100, one or more production wells 104 will typically be disposed within the portion of the coal formation. Formation fluids may be produced through production well 104. Production well 104 may also include a heat source. In this manner, the formation fluids may be maintained at a selected temperature throughout production, thereby allowing more or all of the formation fluids to be produced as vapors. Therefore high temperature pumping of liquids from the production well may be reduced or substantially eliminated, which in turn decreases production costs. Providing heating at or through the production well tends to: (1) inhibit condensation and/or refluxing of production fluid when such production fluid is moving in the production well proximate to the overburden, (2) increase heat input into the formation, and/or (3) increase formation permeability at or proximate the production well.

In the Claims:

Please cancel claims 214 and 745-784 without prejudice.

Listed below is a clean copy of new and amended claims. A marked-up copy of the amended claims is provided in an accompanying document.

531. (amended) A method of treating a coal formation in situ, comprising:

providing heat from one or more heaters to at least a portion of the formation;

allowing the heat to transfer from the one or more heaters to a part of the formation;

controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure; and

producing a mixture from the formation.

532. (amended) The method of claim 531, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

533. (amended) The method of claim 531, further comprising controlling formation conditions, wherein controlling formation conditions comprises maintaining a temperature within the part of the formation within a pyrolysis temperature range of about 270 °C to about 400 °C.

534. (amended) The method of claim 531, wherein at least one of the one or more heaters comprises an electrical heater.

535. (amended) The method of claim 531, wherein at least one of the one or more heaters comprises a surface burner.

536. (amended) The method of claim 531, wherein at least one of the one or more heaters comprises a flameless distributed combustor.

537. (amended) The method of claim 531, wherein at least one of the one or more heaters comprises a natural distributed combustor.

538. (amended) The method of claim 531, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range of about 270 °C to about 400 °C.

539. (amended) The method of claim 531, wherein providing heat from the one or more heaters to at least the portion of formation comprises:

heating a selected volume (V) of the coal formation from the one or more heaters, wherein the formation has an average heat capacity (Cv), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (*Pwr*) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

541. (amended) The method of claim 531, wherein providing heat from the one or more heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C).

554. (amended) The method of claim 531, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

562. (amended) The method of claim 531, further comprising:

providing hydrogen (H_2) to the part of the formation to hydrogenate hydrocarbons within the part of the formation; and

heating a portion of the part of the formation with heat from hydrogenation.

564. (amended) The method of claim 531, wherein allowing the heat to transfer comprises increasing a permeability of a majority of the part of the formation to greater than about 100 millidarcy.

565. (amended) The method of claim 531, wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation.

567. (amended) The method of claim 531, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

568. (amended) The method of claim 531, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.

569. (amended) The method of claim 531, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

570. (amended) A method of treating a coal formation in situ, comprising:

providing heat from one or more heaters to at least a portion of the formation;

allowing the heat to transfer from the one or more heaters to a part of the formation to raise an average temperature within the part of the formation to, or above, a temperature that will pyrolyze hydrocarbons within the part of the formation;

producing a mixture from the formation; and

controlling API gravity of the produced mixture to be greater than about 25 degrees API by controlling average pressure and average temperature in the part of the formation such that the average pressure in the part of the formation is greater than the pressure (p) set forth in the following equation for an assessed average temperature (T) in the part of the formation:

$$p = e^{[-44000/T + 67]}$$

where p is measured in psia and T is measured in Kelvin.

573. (amended) The method of claim 570, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

574. (amended) The method of claim 570, wherein controlling the average temperature

comprises maintaining a temperature in the part of the formation within a pyrolysis temperature range of about 270 °C to about 400 °C.

575. (amended) The method of claim 570, wherein at least one of the one or more heaters comprises an electrical heater.

576. (amended) The method of claim 570, wherein at least one of the one or more heaters comprises a surface burner.

577. (amended) The method of claim 570, wherein at least one of the one or more heaters comprises a flameless distributed combustor.

578. (amended) The method of claim 570, wherein at least one of the one or more heaters comprises a natural distributed combustor.

579. (amended) The method of claim 570, further comprising controlling a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

580. (amended) The method of claim 570, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range of about 270 °C to about 400 °C.

581. (amended) The method of claim 570, wherein providing heat from the one or more heaters to at least the portion of formation comprises:

heating a selected volume (V) of the coal formation from the one or more heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (*Pwr*) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

583. (amended) The method of claim 570, wherein providing heat from the one or more heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C).

595. (amended) The method of claim 570, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

602. (amended) The method of claim 570, further comprising:

providing hydrogen (H_2) to the part of the formation to hydrogenate hydrocarbons within the part of the formation; and

heating a portion of the part of the formation with heat from hydrogenation.

604. (amended) The method of claim 570, wherein allowing the heat to transfer comprises increasing a permeability of a majority of the part of the formation to greater than about 100 millidarcy.

605. (amended) The method of claim 570, wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation.

607. (amended) The method of claim 570, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

608. (amended) The method of claim 570, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.

609. (amended) The method of claim 570, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

623. (amended) A method of treating a coal formation in situ, comprising:

providing heat from one or more heaters to at least a portion of the formation;

allowing the heat to transfer from the one or more heaters to a part of the formation to raise an average temperature within the part of the formation to, or above, a temperature that will pyrolyze hydrocarbons within the part of the formation;

producing a mixture from the formation; and

controlling a weight percentage of olefins of the produced mixture to be less than about 20 % by weight by controlling average pressure and average temperature in the part of the formation such that the average pressure in the part of the formation is greater than the pressure (p) set forth in the following equation for an assessed average temperature (T) in the part of the formation:

$$p = e^{[-57000/T + 83]}$$

where p is measured in psia and T is measured in Kelvin.

665. (amended) A method of treating a coal formation in situ, comprising:

providing heat from one or more heaters to at least a portion of the formation;

allowing the heat to transfer from the one or more heaters to a part of the formation to raise an average temperature within the part of the formation to, or above, a temperature that will

pyrolyze hydrocarbons within the part of the formation;

producing a mixture from the formation; and

controlling hydrocarbons having carbon numbers greater than 25 of the produced mixture to be less than about 25% by weight by controlling average pressure and average temperature in the part of the formation such that the average pressure in the part of the formation is greater than the pressure (p) set forth in the following equation for an assessed average temperature (T) in the part of the formation:

$$p = e^{[-14000/T + 25]}$$

where p is measured in psia and T is measured in Kelvin.

668. (amended) The method of claim 665, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

669. (amended) The method of claim 665, wherein at least one of the one or more heaters comprises an electrical heater.

670. (amended) The method of claim 665, wherein at least one of the one or more heaters comprises a surface burner.

671. (amended) The method of claim 665, wherein at least one of the one or more heaters comprises a flameless distributed combustor.

672. (amended) The method of claim 665, wherein at least one of the one or more heaters comprises a natural distributed combustor.

673. (amended) The method of claim 665, further comprising controlling a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

674. (amended) The method of claim 673, wherein controlling the temperature comprises maintaining a temperature within the part of the formation within a pyrolysis temperature range of about 270 °C to about 400 °C.

675. (amended) The method of claim 665, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range of about 270 °C to about 400 °C.

676. (amended) The method of claim 665, wherein providing heat from the one or more heaters to at least the portion of formation comprises:

heating a selected volume (V) of the coal formation from the one or more heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

678. (amended) The method of claim 665, wherein providing heat from the one or more heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C).

690. (amended) The method of claim 665, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

696. (amended) The method of claim 665, further comprising:

providing hydrogen (H_2) to the part of the formation to hydrogenate hydrocarbons within

the part of the formation; and

heating a portion of the part of the formation with heat from hydrogenation.

698. (amended) The method of claim 665, wherein allowing the heat to transfer comprises increasing a permeability of a majority of the part of the formation to greater than about 100 millidarcy.

699. (amended) The method of claim 665, wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation.

701. (amended) The method of claim 665, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

702. (amended) The method of claim 665, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.

703. (amended) The method of claim 665, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

704. (amended) A method of treating a coal formation in situ, comprising:

providing heat from one or more heaters to at least a portion of the formation;

allowing the heat to transfer from the one or more heaters to a part of the formation to raise an average temperature within the part of the formation to, or above, a temperature that will pyrolyze hydrocarbons within the part of the formation;

producing a mixture from the formation; and

controlling an atomic hydrogen to carbon ratio of the produced mixture to be greater than about 1.7 by controlling average pressure and average temperature in the part of the formation such that the average pressure in the part of the formation is greater than the pressure (p) set forth in the following equation for an assessed average temperature (T) in the part of the formation:

$$p = e^{[-38000/T + 61]}$$

where p is measured in psia and T is measured in Kelvin.

5150. (new) The method of claim 623, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

5151. (new) The method of claim 623, wherein at least one of the one or more heaters comprises an electrical heater.

5152. (new) The method of claim 623, wherein at least one of the one or more heaters comprises a surface burner.

5153. (new) The method of claim 623, wherein at least one of the one or more heaters comprises a flameless distributed combustor.

5154. (new) The method of claim 623, wherein at least one of the one or more heaters comprises a natural distributed combustor.

5155. (new) The method of claim 704, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

5156. (new) The method of claim 704, wherein at least one of the one or more heaters comprises an electrical heater.

5157. (new) The method of claim 704, wherein at least one of the one or more heaters comprises a surface burner.

5158. (new) The method of claim 704, wherein at least one of the one or more heaters comprises a flameless distributed combustor.

5159. (new) The method of claim 704, wherein at least one of the one or more heaters comprises a natural distributed combustor.

5160. (new) The method of claim 704, further comprising controlling a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

5161. (new) The method of claim 5155, wherein controlling the temperature comprises maintaining a temperature within the part of the formation within a pyrolysis temperature range of about 270 °C to about 400 °C.

5162. (new) The method of claim 704, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range of about 270 °C to about 400 °C.

5163. (new) The method of claim 704, wherein providing heat from the one or more heaters to at least the portion of formation comprises:

heating a selected volume (V) of the coal formation from the one or more heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (P_{wm}) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

5164. (new) The method of claim 704, wherein allowing the heat to transfer comprises transferring heat substantially by conduction.

5165. (new) The method of claim 704, wherein providing heat from the one or more heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C).

5166. (new) The method of claim 704, wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°.

5167. (new) The method of claim 704, wherein the produced mixture comprises condensable hydrocarbons, and wherein about 0.1 % by weight to about 15 % by weight of the condensable hydrocarbons are olefins.

5168. (new) The method of claim 704, wherein the produced mixture comprises non-condensable hydrocarbons, and wherein a molar ratio of ethene to ethane in the non-condensable hydrocarbons ranges from about 0.001 to about 0.15.

5169. (new) The method of claim 704, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is nitrogen.

5170. (new) The method of claim 704, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is oxygen.

5171. (new) The method of claim 704, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is sulfur.

5172. (new) The method of claim 704, wherein the produced mixture comprises condensable hydrocarbons, wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons comprise oxygen containing compounds, and wherein the oxygen containing compounds comprise phenols.

5173. (new) The method of claim 704, wherein the produced mixture comprises condensable hydrocarbons, and wherein greater than about 20 % by weight of the condensable hydrocarbons are aromatic compounds.

5174. (new) The method of claim 704, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 5 % by weight of the condensable hydrocarbons comprises multi-ring aromatics with more than two rings.

5175. (new) The method of claim 704, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 0.3 % by weight of the condensable hydrocarbons are asphaltenes.

5176. (new) The method of claim 704, wherein the produced mixture comprises condensable hydrocarbons, and wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons are cycloalkanes.

5177. (new) The method of claim 704, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

5178. (new) The method of claim 704, wherein the produced mixture comprises ammonia, and wherein greater than about 0.05 % by weight of the produced mixture is ammonia.

5179. (new) The method of claim 704, wherein the produced mixture comprises ammonia, and wherein the ammonia is used to produce fertilizer.

5180. (new) The method of claim 704, further comprising controlling formation conditions to produce a mixture of condensable hydrocarbons and H_2, wherein a partial pressure of H_2 within the mixture is greater than about 0.5 bar.

5181. (new) The method of claim 704, wherein a partial pressure of H_2 is measured when the mixture is at a production well.

5182. (new) The method of claim 704, further comprising altering a pressure within the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25.

5183. (new) The method of claim 704, further comprising:

providing hydrogen (H_2) to the part of the formation to hydrogenate hydrocarbons within the part of the formation; and

heating a portion of the part of the formation with heat from hydrogenation.

5184. (new) The method of claim 704, wherein the produced mixture comprises hydrogen and condensable hydrocarbons, the method further comprising hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen.

5185. (new) The method of claim 704, wherein allowing the heat to transfer comprises increasing a permeability of a majority of the part of the formation to greater than about 100 millidarcy.

5186. (new) The method of claim 704, wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation.

5187. (new) The method of claim 704, further comprising controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by Fischer Assay.

5188. (new) The method of claim 704, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

5189. (new) The method of claim 704, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.

5190. (new) The method of claim 704, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

Response To Office Action Mailed October 10, 2002

A. Pending Claims

Claims 531-610, 623-625, 665-706, and 5150-5190 are currently pending. Claims 531-539, 541, 554, 562, 564, 565, 567-570, 573-581, 583, 595, 602, 604, 605, 607-609, 623, 665, 668-676, 678, 690, 696, 698, 699, and 701-704 have been amended. Claims 5150-5190 are new. Claims 214 and 745-784 have been cancelled without prejudice.